



Graduate Student Seminar

Department of Chemistry

Tuesday, June 13th, 2023

Time 14:30

Bldg. 43 Room 015

Michael Muzika

Under the supervision of Dr. Josh Baraban

Development of Laser and Mass Spectrometry Methods for Microreactor Studies of Combustion Chemistry

Chemistry at high temperatures is notoriously difficult to study. Everything reacts with everything, the reaction rates are high, and unstable species (e.g., radicals) are abundant. To examine complex high temperature reactions in a careful and controlled fashion, a dedicated apparatus is required. We have constructed one such instrument in our laboratory. Based on a flash pyrolysis micro-reactor, with soft photoionization mass-spectrometric detection, it is aimed at probing the nascent intermediates and products of the initial microseconds of combustion reactions, while detecting the entire product profile, with an emphasis on radical species. In addition to preliminary results from our lab-scale experiment, I will also present results from similar studies performed on acrolein pyrolysis using advanced apparatus that leverages tunable vacuum ultraviolet radiation at the Swiss Light Source (SLS) synchrotron. Acrolein is a versatile synthetic building block, used in many industrial and pharmacological applications. It is also a common by-product in combustion of biological substances, e.g., forest fires, cigarette smoke, food frying and so on. It is highly reactive and also highly toxic, making it a common pollutant and health hazard. As such, the chemistry of acrolein at high temperature is of much interest. We propose a scheme for acrolein breakdown at high temperatures, which we were able to study at a level of detail inaccessible with other instruments. We intend to employ the experience gained in further studies of even more complex high temperature chemical networks. To that end, we have secured more beam time at the SLS synchrotron to study bimolecular radical reactions.

In my presentation I will focus on the development and employment of the experimental capabilities and the subsequent data analysis techniques for elucidating high temperature reaction mechanisms.